Slimming program for medical operating devices

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Operating devices in the medical sector are not only subject to strict controls and requirements. Nowadays design demands are becoming more and more important for developers of medical HMI devices. Design demands in medical are based on the flattest/ slimmest HMI units possible.

Professional HMI systems must be expertly equipped in terms of quality and technology, not just because of legal requirements. Operating devices in the medical sector are subject to strict controls and requirements. For a few years now, there has also been another aspect, which concerns developers of medical HMI devices: the demands of the customer and end user on the design. Among other criteria, the devices should be fitted with PCAP, Projected Capacitive Touch. Due to the user experience from the end consumer market, the industry customer today knows about feasibility and possibilities and therefore requests operating devices which work just like smartphones, PCs and tablets also for medical applications.

The design demands in medical are based on the flattest/slimmest HMI units possible. What is more, the strict demands applicable to medical applications are also taken into account. A slim device design requires slim components. However, the control is difficult here. A provider such as Data Modul helps their partners in the development and production of HMI systems, whether monitor or panel PC. The company is a certified development and production partner under the number 13485:2016. The distribution range also includes their own product developments. With the eMotion series, Data Modul have developed their own control solution and, with the eMotion USB type C3.1 single-cable solution in alternate mode, have found a way to design even slimmer monitors. Slim designs are also possible with other boards of the eMotion family, such as the ST5.3. The capacitors and plugs are flatter here, a display port interface and DVI and VGA save overall height.

If a panel PC is installed in the application, Data Modul offer their own SBC form factor especially for slim panel PCs: the eDM-SBC-iMX6-PPC. With dimensions of 130 mm x 80 mm x 13 mm, this format offers more width and allows a larger scope for interfaces. Thanks to flatter plugs, where the mating connector is positioned on the side, no structural height is lost when connecting the interface. Even the connection jack of the RJ45 network plug is positioned lower down to design the wireless card to be as flat as possible. TFT-LC displays are seen in industrial applications. However, you should definitely stay away from slimmer consumer panels. They usually do not conform to the industrial demands with regard to lifespan, temperature range, availability and processes for change management and EOL.

An industry customer places value on high readability and a wide viewing angle. For medical devices, displays with MVA, Multiple Vertical Alignment, and IPS, In-Plane Switching, are the best choice. Both technologies offer high quality image display, high color accuracy and wide viewing angles as well as contrast. These are mainly wide and ultra-wide format displays. To see the finest structures and gray tones even on devices with larger diagonals of more than 20", Data Modul's self-developed controller board eMotion UHD II is used. As well as UHD, this also offers HDR, which allows a 10-bit color depth. To find out whether a display is suitable for medical use or not, Data Modul places it under a stress test. This happens in the company's own climate chamber. Here, the displays are exposed to low or high temperatures and temperature cycles depending on the project, application and requirements. This simulates how the panel will behave in continuous or long-term operation. Furthermore, conclusions can be drawn on reliability and quality from the occurring aging effects. For this, the test periods range from a few days/weeks up to several years. This depends on the later use.

The first (capacitive) touch screens entered the market at the beginning of the 1990s. Since then, the basic structure of the touch sensors has barely changed. The basic structure is formed by X and Y levels, usually with a conductive rhombic pattern. Both levels are insulated from each other. If a finger or a conductive medium touches a crossing point

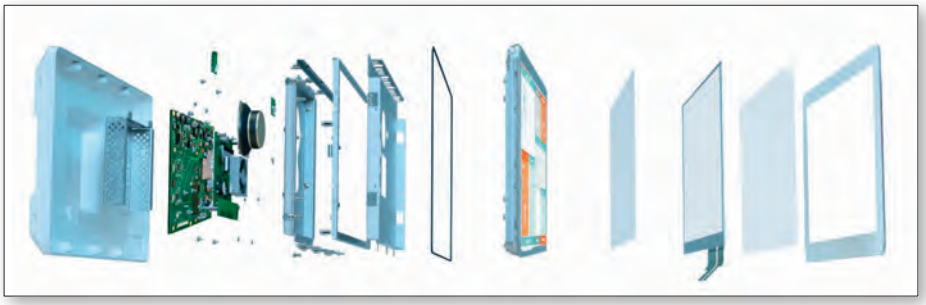

Figure 1. This schematic structure shows the different components of a modern touch display.

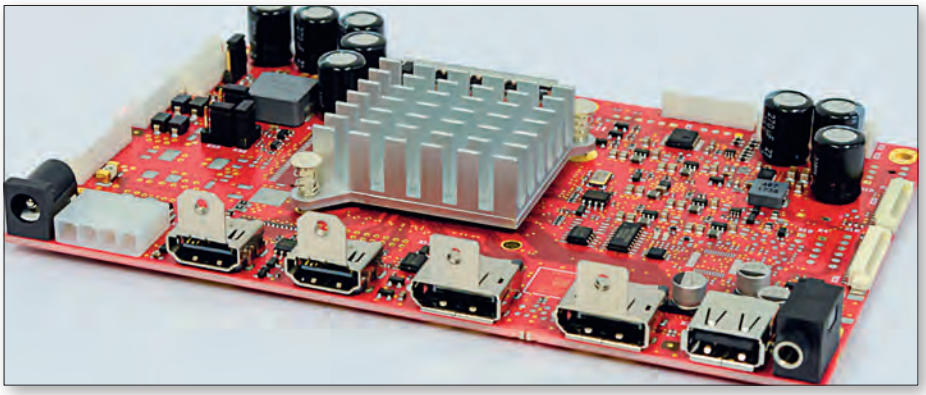

Figure 2. eMotion UHD II: advanced TFT LCD controller board

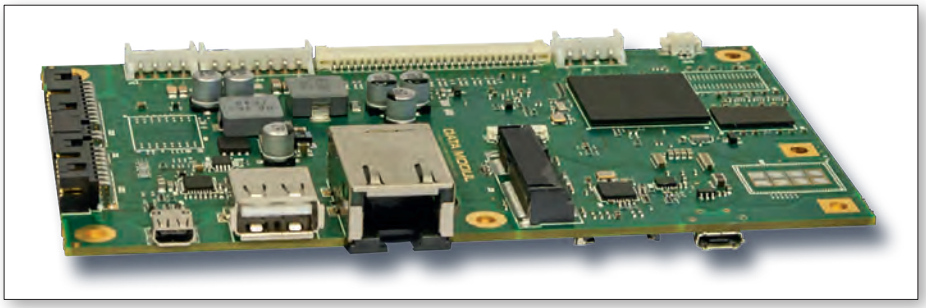

Figure 3. SBC-iMX6-PPC: slim single board computer with NXP i.MX6 Cortex A9 SoC

of both levels, the capacity is changed and a touch event is recognized. HMI systems can be operated based on this principle, even through a glass panel. A central component is the transparent, conductive material ITO, Indium Tin Oxide. This forms a conductive rhombic pattern. In general, the conducting material is applied on two different sensor substrates: glass or PET film. A major drawback owed to the manufacturing procedure is the conductor path of these kinds of sensors and the resulting external dimensions.

All electrodes are connected via a conductor path which leads to the Flextail at the edge of the sensor. With a line/space gap of 100/100 µm, the distance between two conductor paths and the conductor path itself, the structure is wide. This is particularly evident with diagonals bigger than 12.1", since the resolution of these sensors is significantly higher. The glass/glass sensor is barely used in current applications due to the exterior dimensions and the robust overall structure. ITO film sensors (film/film) are thinner. With a sensor structure of 0.5 to maximum 0.7 mm, it is possible to use this in mobile devices. ITO films can be processed very well and the most unconventional shapes are possible. In spite of PET film, temperatures from -20 to 60°C or 70°C are possible. With a combination of a laser and etching processes, a line/space gap of 50/50 µm can be reached. Data Modul has further developed the ITO sensors: SITO, Single-side ITO, which can be applied to diagonals of 7 to 21.5". Unlike film/film sensors, both ITO electrodes in direction X and Y are applied only on one side of a glass substrate. The special feature is that on these crosspoints, metal bridges (metal jumpers) are placed to prevent bypasses caused by the single-layer touch structure. This means that a slimmer edge is possible and the sensor designs can be adapted individually. The external dimensions of the sensors here are not larger than those of the TFT display, meaning the sensors fit in almost every existing customer design. The temperature range is also wider for SITO sensors. PCAP without a glass surface is not possible, the flexible film on its own would not be durable. A thinner, more robust carrier must be applied (glass/film/film). The glass has a purely protective function: it prevents the sensor from bending and the sensitive conductor paths from being destroyed. Carrier glass and cover glass is available in different thicknesses, imprints and/or shapes. With PCAP, the operating surface remains glass and in the medical environment, special anti-bacterial surfaces and glasses are used. Thanks to the anti-bacterial glass and anti-microbial effect of silver ions in the glass, 99 percent of the present bacteria is already dealt with.

Data Modul has taken a special patented nano-free clear glass surface into development. An additional coating becomes unnecessary. The antibacterial effect also remains after cleaning with aggressive products. Other directly antibacterial glass options are lacquered glass, mirror and laminated safety glass, with and without a sound-proofing function. In particular the gap in the device casing must either be narrow or wide to allow it to be cleaned easily. However, a closed device surface is often desired. Data Modul can fill the gap with the gap-filling process or also press-fitting. This requires the engineers involved to be familiar with various materials and the corresponding production procedures.

For design and functionality of the casing design, material, dimensions and production possibilities and feasibility are important. Speakers, cameras, light conductors that are integrated directly into the casing, semi-transparent surfaces and specific surface roughness of the front frame must particularly be taken into account. Data Modul provides their own construction team for the casing concept and integrates the required components in such a way that the casing can be kept as slim as possible.

All EMC demands are also taken into account. CPU boards, touch controllers and sensors are integrated into metal chassis and, thanks to passive filter switching, are not sensitive to interfering signals. The demands on electromagnetic compatibility of medical devices, particularly on those for intensive-care medicine, are very high. Interior chassis made from aluminum improve the emission and immission behavior. Even the touch controller can be integrated. A backshell can be made of compact plastic injection molding ABS plastic, the sealing of which must often correspond to protection type IP54. The integration of the connection field, position and type of plugs also reduces the structural height. In the company's own EMC chambers, the devices are pre-qualified in accordance with medical standard 60601-1.

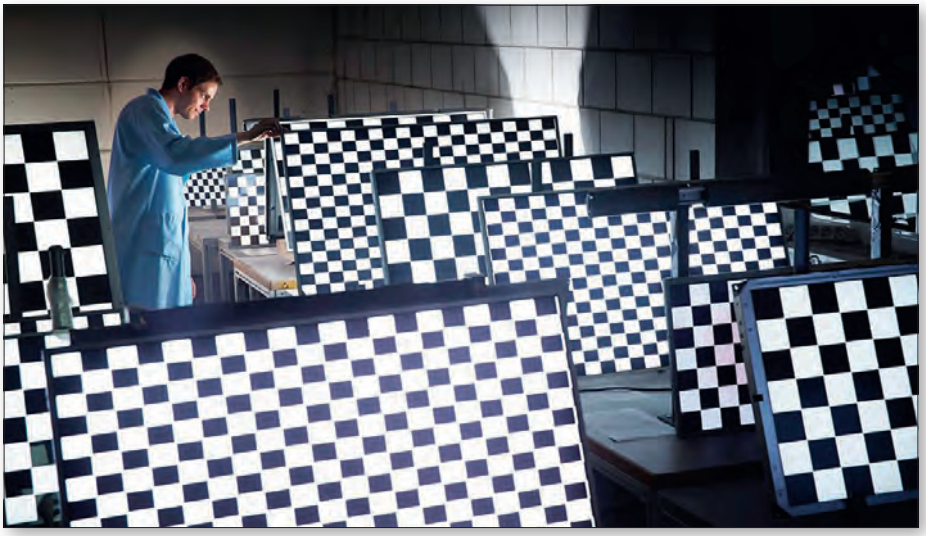

Figure 4. Stress test in the Data Modul climate chamber

Before the start of every series production, detailed qualifications and tests ensure that the production quality will pass. This involves several phases which begin with functional designs and prototypes. Prototypes which are produced in near-serial processes as well as first samples in small quantities are built. The desired functions can be demonstrated and the product samples show the slim design.

Furthermore, the panel and touch functionality can be tested. Parts produced in the rapid prototyping process give important information about the function and fit accuracy before series production. The success a device will have on the market finally depends on the end user. With the presentation of samples/prototypes, the synergy of design and function of the modern, slim medical device can be highlighted. ■